flanged stop **55** abuts a bottom portion **58** of the first circuit board **35**. With the dot pin **29** in its lowered state, the dot pin **29** abuts a top portion of the solenoid winding **39**.

A second embodiment of the present invention is illustrated in FIG. **4**. In the second embodiment, electromechanical transducers are used as the actuating members to provide raised or lowered dot pins. More specifically, each electromechanical transducer **59** includes an electromagnet **61** having a permanently magnetized dot pin **63** located above it, and each dot pin **63** is located within an aperture **27** of the braille board reading surface **15**. Each electromagnet **61** is rigidly secured to a first circuit board **65** of a cordwood circuit board **67**, with the electromagnet **61** thereof having a first lead prong **69** leading to a second circuit board **71** to form an electrical connection therewith and a second lead prong **73** leading to a third circuit board **75** to form an electrical connection therewith. Each dot pin **63** includes a bottom flanged stop **77** to abut a bottom portion of the braille board reading surface **15** when located in a raised state and a top portion of the electromagnet **61** when located in a lowered state. When activated, the electromagnets **61** produces an opposite magnetic polarity to that of the permanently magnetized dot pin **63**. For example, as shown in FIG. **4**, the permanently magnetized dot pins **63** have a north polarity at the top thereof. When an electromagnet **61** is energized, a south polarity is provided at the top thereof to repel the permanently magnetized dot pin **63** located thereover; otherwise, the dot pin rests atop the electromagnet **61**.

The cordwood circuit board **67** has insulating layer **79** located between the first circuit board **65** and the second circuit board **71**, as well as insulating layer **81** located between the second circuit board **71** and the third circuit board **75**. Cordwood circuit board design having insulating layers between successive circuit boards is known in the art, as illustrated by Beierle, made of record.

The microprocessor **99**, as shown in FIG. **5**, controls the operation of the braille board **1** for either the first embodiment using solenoids or the second embodiment using electromechanical transducers as the actuators **100** for placing the dot pins in their raised or lowered states. Memory **101** includes the ROM on which the programming instructions are stored to operate the microprocessor **99**, and also the RAM which allows the microprocessor to store pages of text in alphanumeric data and translate it into braille character data to control the braille board **1**. Petersen discloses a translator for accomplishing this purpose. An algorithm necessary to control the various circuit connectors by the microprocessor **99** in order to provide the braille text to the user on the braille board **1** is easily rendered by the above disclosure.

The microprocessor **99** controls the various actuators **100** through the use chip controller **103**. Chip controller **103** in turn controls a plurality of solid state switches within a chip. For example, a chip **1** controls the top most actuators **100** of the first set of twenty braille cell locations **23** of the first row of braille cell locations **21**. A chip **2** controls the top most actuators **100** of the second set of braille cell locations **23** of the first row of braille cell locations **21**. The next set of twenty actuators **100** directly below those controlled by chip **1** would be controlled by a chip **3** (not show). The set of twenty actuators below those controlled by chip **2** would be controlled by chip **4** (not shown). The system contains 150 chip circuits of solid state switches for providing power to the individual actuators through the second leads or lead prongs thereof connected to the third circuit boards as stated above. The chip controller **103** contains other leads **0** for controlling the odd chips **3**, **5**, **7**, through **149**. The leads E are connected to the even chips **4**, **6**, **8**, through **150**.

Each braille cell (e.g., location **23**) may be a modular unit **105** as illustrated in FIG. **6** for the use of solenoids **33** as the actuators **100** as used in the first embodiment, or a modular unit **107** as illustrated in FIG. **7** for the use of electromechanical transducers as the actuators **100** as used in the second embodiment. Alternatively, the modular design may be a whole row of cells, i.e., 25 cells on one chip. For all of the modular unit designs discussed above, each modular unit would be connectable to a cordwood circuit board. Any number of cordwood circuit boards could be used in order to reduce the number of traces required on each circuit board.

FIG. **8** illustrates a cross-sectional view of an electromechanical transducer **59** as illustrated in FIG. **7**. As stated above, by using a sufficient number of coil turns and by using permanently magnetized dot pins **63**. As shown in FIG. **8**, the electromagnet **61** contains an electromagnet coil **105** wrapped around a cast steel core **107**. For a core diameter d of 0.057" and length 1 of 0.25", where the coil wire has a diameter of 0.003" and the factor of the number of turns times the coil length, NL, is equal to 0.569, a graph as shown in FIG. **9**, indicating the amount of force in grams given a predetermined amount of current passing though the electromagnet coil, can be mathematically derived from the governing formulas relating the electromagnetic force exerted by an electromagnet having the characteristics set forth above.

As shown in FIG. **1**, a control knob **109** may be provided on the braille board **1** so as to allow a user to vary the amount of upward force exerted on the dot pin. For example, if the control knob **109** were turned so as to allow 10 milliamps to pass through each activated electromagnetic coil **105**, an upward force of 5.0 grams would be applied on the dot pin thereof. The control knob **109** allows the user to adjust the upward force exerted on the dot pins so as to adjust the proper upward force on the pins as the user would prefer when "reading" the braille text. With regard to the first embodiment, by varying the amount of current passing through a solenoid **33**, the upward force exerted on the dot pin may be varied in much the same way as in the second embodiment, i.e., by increasing the current passing through a coil, the upward force exerted on the dot pin is also increased. In the preferred embodiment, the control knob **109** could be used to adjust a potentiometer between the chip controller and power supply.

It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the following claims.

I claim:

1. A braille board display device comprising:

data input means for accessing alpha-numeric information from an outside source;

data conversion means for translating said alpha-numeric information into at least one page of braille text, each of said at least one page of braille text containing one-thousand braille cell locations configured into forty columns of cells across and twenty-five lines of cells down, each of said cells having a plurality of dot pin locations to represent one alpha-numeric character, said data conversion means utilizing the maximum number of cells per line in accordance with the last word which will fit on that line; and means for displaying said at least one page of braille text;

said means for displaying includes a braille board reading surface portion having a plurality of apertures there-